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ABSTRACT

Researchers frequently deal with data that are cyclical in nature. This paper presents a methodological procedure that can be used to determine if a roller-coaster effect exists in repeated measures data. The procedure incorporates three key components. First, the researcher may find it necessary to analyze each participant's data set separately in addition to analyzing the aggregated data of participants. In the second component, the Western Electric Zone Rules (from Western Electric's statistical quality control handbook, 1956) are used to determine which changes in the participants' scores are signals of fundamental changes in the scores and which are simply random variations. The third component is that the research must have given considerable forethought to the procedure's criteria, establishing the criterion that will be used to determine if changes constitute peaks or valleys. The researcher must also establish the alpha level that will provide a meaningful power level for the binomial test. The technique is demonstrated through the analysis of the anticipatory grief of seven parents of infants in intensive care who completed an anticipatory grief scale. Analysis through this procedure supported the roller-coaster nature of parents' anticipatory grief, and indicated that it differed across participants. (Contains 8 figures, 12 tables, and 8 references.) (SLD)

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Analyzing Data in a Repeated Measures Design:

A Procedure Used to Determine If the Aggregate Data Should be Analyzed

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Analyzing Data in a Repeated Measures Design:

A Procedure Used to Determine If the Aggregate Data Should be Analyzed

It is quite common for social and medical researchers to deal with data that are cyclical in nature. For example, C. G. Benfield (1995) noted that those parents of infants who are admitted to a neonatal intensive care unit (NICU), as well as the counselors of those parents, often refer to the experience of parenting a high-risk newborn in an NICU as an emotional roller-coaster ride. The potential of ignoring or misinterpreting this roller-coaster effect was noted by Benfield who stated that "researchers seem to have overlooked the curvilinear implications of the 'roller-coaster ride' metaphor when designing their investigations and interpreting their results, concluding instead that parents' emotional response patterns decline linearly over time" (p. 16).

When attempting to determine if a roller-coaster effect exists in a set of time-series data, it is essential for researchers to employ the appropriate analytical tools in order to avoid committing a Type VI error (Newman, Deitchman, Burkholder, Sanders, and Ervin, 1976). That is, the researcher must use an analytical technique that appropriately addresses the research question. If the time-series data are cyclical and the cycles are common across individuals, it may be possible for the researcher to detect those cycles by analyzing the aggregated data. Such detection would allow the researcher to identify cycles for the study's participants as a whole. If the study's participants do not experience the peaks and valleys at the same points in time, however, an analysis of the aggregated data may mislead the researcher to conclude that no such roller-coaster effect is present. That is, the analysis of the aggregated data may not allow the researcher to identify the cyclical motion of the values because the peak experienced by one individual for a given time period may be negated by another individual's valley. Thus, analyzing

only the aggregated data may lead the researcher to conclude that a roller-coaster effect is not present in spite of the fact that a number, if not all, of the participants experienced such a pattern.

In this paper, we present an analytical technique that a researcher could use to determine if the values obtained through a repeated-measures design do, in fact, reveal a roller-coaster effect. This technique, which utilizes the statistical tools of multiple regression models, quality control limits, the Western Electric Zone Rules, and the binomial test, gives special attention to whether it is appropriate to analyze the aggregated data or whether it is necessary to analyze each participant's data set separately.

Analytical Technique Used to Detect a Roller-Coaster Effect

The research question that our technique is designed to test is: Do the time-series scores indicate that a roller-coaster effect exists? It may appear that the researcher can address this question by analyzing only the aggregated data. As previously discussed, by analyzing the aggregate data, the researcher may not be able to detect a roller-coaster effect. The procedure presented in this section requires that the researcher begin the data analysis with the aggregate and possibly continue the investigation by analyzing each participant's set of scores separately.

Procedure

When implementing the technique that we are proposing, the researcher follows six steps. The first three steps involve the analysis of the aggregate data and the remaining three steps require that each participant's set of values be analyzed separately.

Step 1. The researcher constructs and analyzes multiple linear regression models that are designed to test the time-by-person interaction effect. In this step the researcher must determine the criteria that will be used to determine if the interaction effect is statistically and

practically significant. If a time-by-person interaction effect is not statistically and practically significant, it may be appropriate to analyze the aggregate scores and the researcher would proceed to Step 2. If a time-by-person interaction effect is statistically and practically significant the set of scores for each participant should be analyzed separately. The researcher would continue this analysis procedure by skipping to Step 4.

Step 2. The researcher must determine if the regression coefficient for the time variable contained in the Restricted Model, which was constructed in Step 1, is statistically and practically significant. Again, the researcher must establish the criteria that will be used to determine if the regression coefficient for the time variable is statistically and practically significant. If the time variable is not statistically and practically significant, the researcher should use the participants' scores in Step 3. If the time variable is statistically and practically significant, the researcher would record the residual values that are produced by the Restricted Model used in Step 1. These residual values rather than the actual scores would be analyzed in Step 3.

Step 3. The researcher calculates the mean of the participants' scores or residual values for each time period. Next, the researcher would calculate the one-, two-, and three-sigma limits for these mean values. As suggested by Wheeler (1994), the Western Electric Zone Rules would be used to determine if the changes in the mean scores or mean residual values that occurred over time reflect positive and negative shifts or if they simply reflect random variations. The Western Electric Zone Rules are as follows (Statistical Quality Control Handbook, 1956):

Rule 1: At least one value is located outside of either of the three-sigma limits.

Rule 2: Two of three successive points are located outside of the same two-sigma limit.

Rule 3: Four of five successive points are located outside of the same one-sigma limit.

Rule 4: Eight successive points are located on the same side of the mean value.

If observed changes in the values are deemed not to be caused by random variation, the researcher must determine whether the changes can be identified as peaks or valleys. A change in the values is deemed to be a peak when the values immediately preceding the change are below the values identified as included in the change. A valley requires that the values immediately proceeding the change be lower than the values included in the change. In addition to detecting changes and identifying whether they are peaks or valleys, the research must decide how many peaks and valleys are required to establish that a roller-coaster effect is present. This criterion may vary across disciplines.

If a roller-coaster effect is deemed to exist through this analysis, the research hypothesis corresponding to the roller-coaster research question is supported. If the researcher is not able to identify that a roller-coaster effect exists at this point, the researcher should not assume that the research hypothesis cannot be supported. Each participant's set of values should be analyzed separately before such a conclusion can be drawn.

Step 4. The researcher regresses the scores on the time variable for each participant separately. If the regression coefficient is not statistically and practically significant for a given participant, that participant's actual scores would be used in Step 5. If the regression coefficient is statistically and practically significant for a given participant, that participant's residual values, which are obtained by regressing that participant's scores on the time variable, would be used in Step 5.

Step 5. The researcher calculates the one-, two-, three-sigma limits for each participant's values or residual values. The Western Electric Zone Rules would be used to determine which changes were not assumed to be due to random variation in those values. As part of this step, the researcher would determine if any change in the values that were not attributed to random variation constituted a peak or valley. The researcher would complete this step by determining if the number of peaks and valleys constituted a roller-coaster effect for each participant.

Step 6. The researcher determines the number and proportion of the study's participants who do and do not exhibit the roller-coaster effect. Next, the researcher uses the binomial test to calculate the probability of obtaining no more than the number of participants who exhibited the roller-coaster effect. If this probability value was less than the criterion established by the researcher, the researcher would conclude that the data did support the roller-coaster effect research hypothesis. It should be noted that the criterion used by the researcher in this step may be set at a level higher than the typical .05 level.

Rationale

It is important for the researcher to understand the rationale for each of these steps. Step 1 is designed to determine if the participants have a common linear trend in their values. If the researcher determines that a time-by-person interaction effect does in fact exist, that is, the participants do not have a common linear trend, it would be inappropriate to analyze the aggregate data. In such a case, the researcher should continue to investigate the possible existence of a roller-coaster effect by analyzing the set of values of each participant separately by proceeding to Step 4. If the researcher determines that a time-by-person interaction effect does not exist, which indicates that the participants' scores have a common trend, the analysis of the

aggregate data may still be able to reveal a roll-coaster effect. In this case, the researcher should proceed to Step 2.

Step 2 allows the researcher to determine if the aggregated scores reflect a statistically and practically significant linear trend. If a trend does exist, the researcher would record the participants residual values that were produced by the Restricted Model analyzed in Step 1. These residual values would be used in Step 3 in order to remove the trend from the values. If a trend is not present, the researcher would use the participants' actual scores in Step 3.

Step 3 allows the researcher to determine if a roller-coaster effect exists by analyzing aggregated data. If the Western Electric Zone Rules identify changes in the values that are not attributed to random variation and these changes meet the criteria established by the researcher to demonstrate a roller coaster effect, the research hypothesis dealing with the existence of a roller-coaster effect is supported. If the roller-coaster effect is not revealed in this step, the researcher should not conclude that such an effect is absent. The lack of a roller-coaster effect may be the function of the aggregated data. That is, the peaks experienced by some individuals that occur in a given time period may be compromised by the valleys experienced other individuals during the same time period. When a roller-coaster effect is not found in the aggregate data, the researcher would continue the data analysis by analyzing each participant's set of values separately.

Step 4 is designed to allow the researcher to determine if the Western Electric Zone Rules should be applied to each person's scores or regression residual values. The researcher would regress each person's scores on the time variable. A separate regression analysis would be conducted for each of the study's participants. If the regression coefficient for the time variable was statistically and practically significant for any individual, the researcher would conclude that

the participant's scores reflected a trend. To increase the chance that the Western Electric Zone Rules can detect shifts that are associated with a roller-coaster effect in a given participant's scores, the participant's regression residual values, which are independent of the trend, would be used in Step 5. If the regression coefficient for the time variable is not statistically and practically significant for a given participant, the Western Electric Zone Rules would be applied to that person's actual scores in Step 5.

In Step 5, the one-, two-, and three-sigma limits are calculated for each participant's set of scores separately. The Western Electric Zone Rules are applied to each participant's set of scores or regression residual values to determine if shifts have occurred. In addition, the researcher must determine if those changes meet the criteria used to define a roller-coaster effect. The roller-coaster effect may be evident only when examining each participant's set of values separately. The examination of the aggregated data, which was conducted in Steps 1 through 3, may not have revealed the presents of the roller-coaster effect.

In Step 6, the researcher determines the number and proportion of participants who did and did not exhibit the roller-coaster effect. The binomial test is used to calculate the probability that one would expect to find, by chance, the proportion of participants in the study who did not exhibit the roller-coaster effect. If this probability value is less than the criterion established by the researcher, the researcher would conclude that the roller-coaster effect research hypothesis is supported by the data. The criterion used in conjunction with the binomial test should not be automatically set at the traditional .05 level. With small or even moderate sample sizes, the probability generated by the binomial test will be relatively high even when the percentage of participants who exhibit the roller-coaster effect reaches or exceeds the relatively high level of

60%. To maintain a viable power level, it would be appropriate to set a relatively high alpha level. The alpha value should be set at a level that allows the researcher to support the roller-coaster effect research hypothesis when the proportion of participants who exhibit the effect approaches what is deemed to be practically significant level. For example, if one third of the participants exhibited the roller-coaster effect, the researcher would, in all likelihood, want to suggest that a roller-coaster effect was a factor among the participants. In this case, the alpha value should be set at a level that would allow the researcher to support the research hypothesis when at least one third of the participants exhibit the effect.

Application of the Technique to the Anticipatory Grief Scores

As a means of presenting our analytical technique, as well as demonstrating how it can be applied, we have used the technique to analyze anticipatory grief of seven parents with infants who had been admitted to the NICU of Akron Children's Medical Center. These parents' data were included in a study conducted by C. G. Benfield (1995). The research question that we are investigating is: Do the anticipatory grief scores of parents with infants in a NICU reflect a roller-coaster effect? The parents' anticipatory grief was measured with the seven-item Anticipatory Grief Scale that was developed by D. G. Benfield, Leib and Reuter (1976). The seven grief scale items were as follows: (a) feelings of sadness, (b) loss of appetite, (c) inability to sleep, (d) increased irritability, (e) preoccupation thinking about the baby, (f) thinking one had done something to cause the baby's problem, and (g) feelings of anger.

The parents rated themselves on each of the seven items on the scale that ranged in value from 0 to 3, with the values of 0 and 3 indicating never a problem and a big problem, respectively. Each parent's anticipatory grief score was obtained by adding his or her seven ratings. Thus, a

parent's score could range from 0 to 21. Each parent completed the Anticipatory Grief Scale 40 times. Thus, our data base consisted of 40 anticipatory grief scores for each of the seven participants.

In Step 1, the time-by-person interaction effect was tested. We were willing to state that such an interaction effect did exist when the probability of the F test of the difference between the R^2 values of the Full and Restricted Models was less than .05 and the effect size of this interaction effect exceeded .25. The effect size was measured with Cohen's f^2 value (Cohen, 1977; see also McNeil, Newman, & Kelly, 1996), which is equal to the difference between the R^2 value of the Full Model and the R^2 value of the Restricted Model divided by the quantity of one minus the R^2 value of the Full Model.

The variables used to form the Full and Restricted Models are listed in Table 1 and the regression results are listed in Table 2. The F test of the difference between the R^2 values of the Full and Restricted Models revealed that the time-by-person interaction effect was not statistically significant [$F(6,266) = 1.08, p = .37$]. In addition, the f^2 value of .02 was less than the practically significant threshold value of .25. Thus, a time-by-person interaction effect was deemed not to exist.

 Insert Tables 1 and 2 about here

In Step 2 the regression coefficient of the time variable was tested. The same criteria that were used in Step 1 to determine statistical and practical significance were applied to the analysis conducted in this step. That is, the probability of the t test of the time variable coefficient, which

was part of the regression analysis of the Restricted Model, had to be less than .05 before we would consider the time variable coefficient to be statistically significant. Also the f^2 value had to exceed .25 before a positive or a negative trend would be declared to be practically significant.

The results contained in Table 2 indicated that the coefficient for the time variable ($b = -.05$) did meet the statistically significant criterion [$t(272) = -2.897, p = .004$]. The f^2 value ($f^2 = .03$) for this coefficient, however, did not reach the preestablished level of .25. Since we required the coefficient to be practically significant as well as statistically significant before we would be willing to assume that the aggregated data set reflected a trend, we proceed to Step 3 under the assumption that the scores did not reflect a positive or a negative linear trend. Since there was no need to adjust the scores for a linear trend in Step 3, we used the anticipatory grief scores rather than the residuals generated from the regression analysis of the Restricted Model.

In Step 3 the one-, two- and three-sigma limits were calculated along with the grand mean for the 40 mean scores. The 40 mean scores and the range of scores for each time period are listed in Table 3. Following normal quality control chart procedures (Wheeler, 1993, 1994), an estimate of the standard deviation value ($\sigma = 4.8$) was obtained by dividing the mean of the moving range values ($mR = 13.0$) by the constant 2.704. Since a mean value for each time period was being analyzed, an estimate of the standard error the mean was needed to construct the one-, two-, three-sigma limits. The standard error the mean estimate ($\sigma_{\bar{x}} = 1.8$) was obtained by dividing the standard deviation estimate by the square root of seven, which was the number of scores observed during each time period. The limits, along with the grand mean of the aggregated data ($\bar{\bar{X}} = 7.9$), are listed in Table 4.

Insert Tables 3 and 4 about here

A chart containing the 40 means and the three sets of limits is contained in Figure 1. The number of standard error of the mean units that each mean score was located above or below the grand mean is listed in Table 4. The Western Electric Zone Rules were applied to those 40 values to determine if any changes in the mean scores indicate the existence of a signal or simply random variation (noise).

Before these rules were applied, however, we had to establish two criteria. First, we had to determine what conditions were necessary for a value or a set of values to be labeled a peak or a valley. Second, we had to establish the number of peaks and valleys that would be needed to represent a roller-coaster effect. A shift was considered to be a peak when the values contained in the shift were higher than the values immediately preceding and following the shift. In like manner, a shift was considered to be a valley if the values contained in the shift were lower than the values immediately preceding and following the shift. In addition, the values that were contained in the time period between two valleys also constituted a peak even when the Western Electric Zone Rules failed to identify a shift for that time period. A corresponding criterion was used to identify a valley. With respect to the identification of a roller-coaster effect, we required that at least two peaks and one valley or one peak and two valleys exist before a roller-coaster effect was deemed to be present.

Insert Figure 1 about here

When the Western Electric Zone Rules were applied to the number of standard error of the mean units that the means were located above or below the grand mean, only one shift in the values was identified. Since one shift was not sufficient to identify a roller-coaster effect, the analysis of the aggregate data did not support the research hypothesis. Before we could conclude that the anticipatory grief scores do not reflect a roller-coaster effect, however, we had to analyze each participant's set of scores individually.

In Step 4, we regressed each participant's scores on the time variable to determine if a linear trend existed for each person. The results of these regression analyses are contained in Table 5. A linear trend was considered to exist if the coefficient for the time variable was statistically significant and practically significant. The criteria for statistical and practical significance were the same as those used in the Steps 1 and 2. The coefficient values for all but Participants 5 and 6 did not reach the statistical significant criteria of .05. The coefficient for Participant 6, however, was the only coefficient to meet the practically significant criterion of .25. The amount of variation in the scores associated with the time variable produced an f^2 value of .35, which exceeded the threshold value of .25. Thus, the anticipatory grief scores for all of the participants, except Participant 6, were used in Step 5. Since we considered the anticipatory grief scores for Participant 6 to reflect a negative linear trend, the residual values of Participant 6 were analyzed in the next step. These residual values were obtained by regressing the scores of Participant 6 on the time variable.

Insert Table 5 about here

In Step 5 the one-, two- and three-sigma limits were calculated for each participant. The limits for each participant were calculated by first calculating the participant's moving range values. The mean of these moving range values was divided by the constant 1.128 in order to obtain an estimate of the participant's standard deviation (Wheeler 1994). Since the values being analyzed were individual observations rather than means, as was the case in Step 3, the estimated standard deviation value rather than the standard error of the mean estimate was used to establish the one-, two-, and three-sigma limits around the participant's mean value. The limits for each participant are listed in Table 5.

Tables 6 through 12 contain the anticipatory grief values (residual values for Participant 6), the moving range values, and the number of standard deviation units that each value is located above or below the mean value for each participant. The charts containing the participants' values and limits are contained in Figures 2 through 8. We applied the Western Electric Zone Rules to each participant's values and the criteria used in Step 3 to identify peaks and valleys. The results were as follows:

1. Participant 1 had four peaks and four valleys.
2. Participant 2 had no peaks or valleys.
3. Participant 3 had one peak and no valleys.
4. Participant 4 had one peak and two valleys.
5. Participant 5 had two peaks and one valley.

6. Participant 6 had two peaks and three valleys.

7. Participant 7 had two peaks and two valleys.

Since we required a participant to have at least two peaks and one valley or one peak and two valleys to reflect a roller-coaster effect, five of the seven participants were considered to exhibit such an effect.

Insert Tables 6 through 12 about here

Insert Figures 2 through 8 about here

In Step 6 we set the alpha level for the binomial test at .30. We determined that five of the seven participants exhibited a roller-coaster effect. As indicated by the binomial test, the probability that a maximum of two of the seven participants would not exhibit the roller-coaster effect was equal to .227. Since the probability value of .227 was less than the preestablished alpha level of .30, we believe that it was appropriate to conclude that the research hypothesis, which states that parents of premature infants who are admitted to a NICU experience a roller-coaster effect with respect to their anticipatory grief, was fundamentally supported. The difference in the results of the analysis of the aggregated data and the individual analyses of the participants' scores also suggests that the type of roller-coaster effect, that is, the number and location the peaks and valleys, differ across participants.

Summary

This paper presented a methodological procedure that can be used to determine if a roller-coaster effect exists in repeated-measures data. This analytical procedure incorporated three key components. First, when using this procedure, the researcher may find it necessary to analyze each participant's data set separately as well as analyze the aggregated data of the participants before a conclusion can be reached regarding the existence of a roller-coaster effect. Second, the Western Electric Zone Rules are used to determine which changes in the participants' scores are signals of fundamental changes in the scores and which changes are simply random variations. Third, the research must given considerable forethought to several of the criteria used in the procedure. For example, the research must determine how a fundamental change in the scores will be identified. We used the Western Electric Zone Rules to identify such changes. The researcher may find, however, that another criterion is more useful for the data being examined. In addition, the researcher must establish the criterion that will be used to determine if changes in the values constitute peaks or valleys. And the researcher must establish the alpha level that will provide a meaningful power level for the binomial test.

We hope that this paper will sensitize its readers to two essential points that must be addressed by any technique that is used to search for a possible roller-coaster effect in time-series data. First, analyzing only the aggregate data may be insufficient. Such an analysis may only reveal the existence of a roller-coaster effect when each participant experiences peaks and valleys at the same points in time. Analysis of each participant's scores may be required to reveal the existence of a roller-coaster effect. Second, the researcher must be able to separate random variations in the scores from possible peaks and valleys.

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Table 1

Variables Used in the Regression Models

Variable symbol	Composition of the variable
Y	Grief Scores
X ₁	Person one vector = 1 if score was from person one; 0 otherwise
X ₂	Person two vector = 1 if score was from person two; 0 otherwise
X ₃	Person three vector = 1 if score was from person three; 0 otherwise
X ₄	Person four vector = 1 if score was from person four; 0 otherwise
X ₅	Person five vector = 1 if score was from person five; 0 otherwise
X ₆	Person six vector = 1 if score was from person six; 0 otherwise
X ₇	Person seven vector = 1 if score was from person seven; 0 otherwise
X ₈	Time period = 1 through 40
X ₉	$X_1 * X_8$
X ₁₀	$X_2 * X_8$
X ₁₁	$X_3 * X_8$
X ₁₂	$X_4 * X_8$
X ₁₃	$X_5 * X_8$
X ₁₄	$X_6 * X_8$
X ₁₅	$X_7 * X_8$

Table 2

Regression Analysis of the Time $\times$ Person Interaction Effect

Full model

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13} + b_{14}X_{14} + b_{15}X_{15} + e$$

Restriction

$$b_9 = b_{10} = b_{11} = b_{12} = b_{13} = b_{14} = b_{15}$$

Restricted model

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_8X_8 + e$$

$$R^2 \text{ full model} = .468$$

$$R^2 \text{ restricted model} = .455$$

$$df_n = 6$$

$$b_1 = -.05$$

$$df_d = 266$$

$$df = 272$$

$$F = 1.08$$

$$t = -2.897$$

$$p = .37$$

$$p = .004$$

$$f^2 = .02$$

$$f^2 = .03$$

Table 3

Analysis of the Aggregated Grief Scores

Time period	Mean grief scores	Ranges of the grief scores	Number of standard error of the mean units above or below grand mean ^a
1	10.29	10	+1
2	7.29	14	-0
3	8.86	13	+0
4	10.86	14	+1
5	8.29	11	+0
6	9.14	16	+0
7	10.00	9	+0
8	9.14	8	+0
9	8.71	8	+0
10	6.57	12	-0
11	6.14	13	-0
12	8.29	18	+0
13	9.29	18	+0
14	8.14	19	+0
15	7.57	18	-0
16	7.43	19	-0

(table continues)

Time period	Mean grief scores	Ranges of the grief scores	Number of standard error of the mean units above or below grand mean ^a
17	6.71	13	-0
18	6.43	13	-0
19	5.71	12	-1
20	8.29	15	+0
21	10.00	16	+1
22	10.71	11	+1
23	9.43	9	+0
24	6.14	10	-0
25	6.57	14	-0
26	8.71	13	+0
27	7.57	10	-0
28	7.57	14	-0
29	8.14	14	+0
30	8.00	9	+0
31	8.14	12	+0
32	8.00	9	+0
33	6.71	16	-0
34	6.00	13	-1

(table continues)

Time period	Mean grief scores	Ranges of the grief scores	Number of standard error of the mean units above or below grand mean ^a
35	6.00	12	-1
36	7.80	13	-0
37	6.86	13	-0
38	7.29	12	-0
39	7.00	15	-0
40	6.57	10	-0

Decrease

^aA plus indicates that the mean was above the grand mean and a minus indicates that the mean was below the grand mean.

Table 4

Limits for the Grief Scores

Participant	Mean	One-sigma limit	Two-sigma limit	Three-sigma limit
All	7.9	6.1 and 9.7	4.3 and 11.5	2.5 and 13.3
Person 1	6.8	3.9 and 9.7	1.0 and 12.6	0 and 15.5
Person 2	8.6	6.1 and 11.1	3.6 and 13.6	1.1 and 16.1
Person 3	14.0	12.3 and 15.7	10.6 and 17.4	8.9 and 19.1
Person 4 ^a	3.9	1.6 and 6.2	0 and 8.5	0 and 10.8
Person 5	9.3	7.1 and 11.5	4.9 and 13.7	2.7 and 15.9
Person 6 ^b	0.00	-.75 and .75	-1.50 and 1.50	-2.25 and 2.25
Person 7	5.9	4.2 and 7.6	2.5 and 9.3	.8 and 11.0

^aThe lower limits of the two-sigma and three-sigma limits were truncated to zero.

^bThe regression residual values were used for Person 6.

Table 5

Regression Analyses of the Time Variable for Each Participant

Person identification number	Time coefficient value	t value	p value	f ² value
1	-.09	-1.40	.17	.05
2	-.02	-.09	.57	.01
3	+.03	.92	.36	.02
4	-.01	-.14	.89	.01
5	-.10	-2.59	.014 ^a	.18
6	-.09	-3.64	.008 ^a	.35 ^b
7	-.07	-1.56	.13	.06

^aStatistically significant at the .05 level.

^bPractically significant $f^2 > .25$.

Table 6

Analysis of the Grief Scores for Person 1

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
1	17	---	+3] Peak
2	4	13	+0] Valley
3	16	12	+3]
4	20	4	+3] Peak
5	8	12	+0]
6	6	2	-0]
7	6	0	-0]
8	4	2	-0]
9	4	0	-0]
10	3	1	-1]
11	3	0	-1] Valley
12	4	1	+0]
13	5	1	+0]
14	5	0	+0]
15	6	1	+0]
16	19	13	+3] Peak

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score	
17	7	12	+0	
18	3	4	-1	Valley
19	5	2	-0	
20	5	0	-0	
21	3	2	-1	
22	5	2	-0	
23	6	1	-0	
24	3	3	-1	
25	5	2	-0	
26	6	1	-0	
27	4	2	-0	
28	11	7	+1	
29	16	5	+3	Peak
30	10	6	+1	
31	11	1	+1	
32	10	1	+1	
33	4	6	-0	Valley
34	3	1	-1	

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
35	3	0	-1
36	3	0	-1
37	3	0	-1
38	6	3	-0
39	6	0	-0
40	3	3	-1

Valley

Table 7

Analysis of the Grief Scores for Person 2

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
1	9	---	+0
2	6	3	-1
3	6	0	-1
4	11	5	+0
5	6	5	-1
6	14	8	+2
7	10	4	+0
8	11	1	+0
9	11	0	+0
10	7	4	-0
11	5	2	-1
12	11	6	+0
13	13	2	+1
14	12	1	+1
15	10	4	+0
16	6	0	-0

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
17	6	0	-0
18	7	1	-0
19	7	0	-0
20	7	0	-0
21	8	1	-0
22	13	5	+1
23	8	5	-0
24	4	4	-1
25	12	8	+1
26	12	0	+1
27	8	4	-0
28	8	0	-0
29	7	1	-0
30	8	1	-0
31	4	4	-1
32	7	3	-0
33	8	1	-0
34	9	1	+0

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
35	8	1	-0
36	13	5	+1
37	9	4	+0
38	10	1	+0
39	4	6	-1
40	10	6	+0

Table 8

Analysis of the Grief Scores for Person 3

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
1	12	---	-1
2	16	4	+1
3	11	5	-0
4	10	1	-0
5	14	4	0
6	13	1	-0
7	14	1	0
8	12	2	-1
9	12	0	-1
10	13	1	-0
11	13	0	-0
12	18	5	+2
13	19	1	+2
14	19	0	+2
15	18	1	-1
16	11	7	+0

Peak

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
17	15	4	+0
18	15	0	+0
19	12	3	-1
20	10	2	-2
21	14	4	0
22	12	2	-1
23	14	2	0
24	13	1	-0
25	15	2	+0
26	14	1	0
27	14	0	0
28	15	1	+0
29	15	0	+0
30	13	2	-0
31	15	2	+0
32	14	1	0
33	17	3	+1
34	14	3	0

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
35	12	2	-1
36	14	2	0
37	14	0	0
38	14	0	0
39	17	3	+1
40	13	4	-0

Table 9

Analysis of the Grief Scores for Person 4

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
1	7	---	+1
2	2	5	-0
3	3	1	-0
4	6	3	+0
5	3	3	-0
6	0	3	-1
7	6	6	+0
8	6	0	+0
9	5	1	+0
10	1	4	-1
11	0	1	-1
12	0	0	-1
13	1	1	-1
14	0	1	-1
15	0	0	-1
16	0	0	-1

Valley

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
17	2	2	-0
18	2	0	-0
19	0	2	-1
20	19	19	+3
21	19	0	+3
22	16	3	+3
23	9	7	+2
24	6	3	+0
25	1	5	-1
26	5	4	+0
27	4	1	+0
28	1	3	-1
29	2	1	-0
30	4	2	+0
31	3	1	-0
32	6	3	+0
33	1	5	-1
34	1	0	-1

Peak

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
35	0	1	-1 ▲
36	1	1	-1] Valley
37	2	1	-0]
38	5	3	+0
39	2	3	-0
40	4	2	+0

Table 10

Analysis of the Grief Scores for Person 5

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score	
1	11	---	+0	
2	10	1	+0	
3	10	0	+0	
4	9	1	-0	
5	12	3	+1	Peak
6	16	4	+2	
7	15	1	+2	
8	11	4	+0	
9	12	1	+1	
10	8	4	-0	
11	10	2	+0	
12	14	4	+2	
13	13	1	+1	
14	8	5	-0	
15	7	1	-1	Valley
16	7	0	-1	

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
17	7	0	-1 ▲
18	9	2	-0
19	7	2	-1
20	5	2	-1
21	5	0	-1
22	8	3	-0]
23	13	5	+1
24	7	6	-1
25	5	2	-1
26	16	11	+3 Peak
27	12	4	+1
28	7	5	-1
29	7	0	-1
30	9	2	-0
31	11	2	+0
32	9	2	-0
33	7	2	-1
34	7	0	-1

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
35	7	0	-1
36	12	5	+1
37	10	2	+0
38	7	3	-1
39	8	1	-0
40	4	4	-2

Table 11

Analysis of the Residual Values for Person 6

Time Period	Residual Values	Moving ranges of the residual values	Number of standard deviation units above or below the mean score
1	-1.74	---	-1
2	-2.65	.91	-3 Valley
3	-.56	2.09	-0
4	2.53	3.09	+3 Peak
5	-.38	2.91	-0
6	.71	1.09	+0 } Valley
7	2.80	2.09	+3
8	2.89	.09	+3
9	1.98	.91	+2
10	2.07	.09	+2
11	2.16	.09	+2
12	1.26	.90	+1
13	1.34	.08	+1
14	2.44	1.10	+3
15	.53	1.91	+0
16	-1.38	1.91	-1

(table continues)

Time Period	Residual Values	Moving ranges of the residual values	Number of standard deviation units above or below the mean score
17	-1.29	.09	-1
18	-2.20	.91	-2
19	-3.11	.91	-3
20	-3.02	.09	-3
21	-2.93	.09	-3
22	-1.84	1.09	-2
23	-1.75	.09	-2
24	-1.66	.09	-2
25	-1.57	.09	-2
26	-1.48	.09	-1
27	-1.39	.09	-1
28	-1.30	.09	-1
29	-.21	1.09	-0
30	.88	1.09	+0
31	-.02	.90	-0
32	-.93	.91	-1
33	1.16	2.09	+1
34	.25	.91	+0

Valley

(table continues)

Time Period	Residual Values	Moving ranges of the residual values	Number of standard deviation units above or below the mean score	
35	1.34	1.09	+1	Peak
36	1.43	.09	+1	
37	.52	.91	+0	
38	1.61	1.09	+1	
39	1.70	.09	+1	
40	1.79	.09	+1	

Table 12

Analysis of the Grief Scores for Person 7

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score	
1	9	---	+1	Peak
2	7	2	+0	
3	8	1	+1	
4	9	1	+1	
5	7	2	+0	
6	6	1	+0	
7	8	2	+1	
8	9	1	+1	
9	7	2	+0	
10	4	3	-1	Valley
11	2	2	-2	
12	2	0	-2	
13	5	3	-0	
14	3	2	-1	
15	4	1	-1	
16	3	1	-1	

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
17	4	1	-1 ▲
18	4	0	-1
19	5	1	-0]
20	8	3	+1
21	17	9	+3]
22	16	1	+3
23	11	5	+3]
24	5	6	-0
25	3	2	-1
26	3	0	-1
27	6	3	+0
28	6	0	+0
29	4	2	-1
30	5	1	-0
31	7	2	+0
32	5	2	-0]
33	3	2	-1
34	2	1	-2 ▼

(table continues)

Time Period	Grief scores	Moving range of the grief scores	Number of standard deviation units above or below the mean score
35	7	0	-0
36	12	5	-0
37	10	2	-0
38	7	3	-2
39	8	1	-0
40	4	4	-2

Valley

Figure Captions

Figure 1. Mean anticipatory grief scores for all of the participants.

Figure 2. Anticipatory grief scores for participant 1.

Figure 3. Anticipatory grief scores for participant 2.

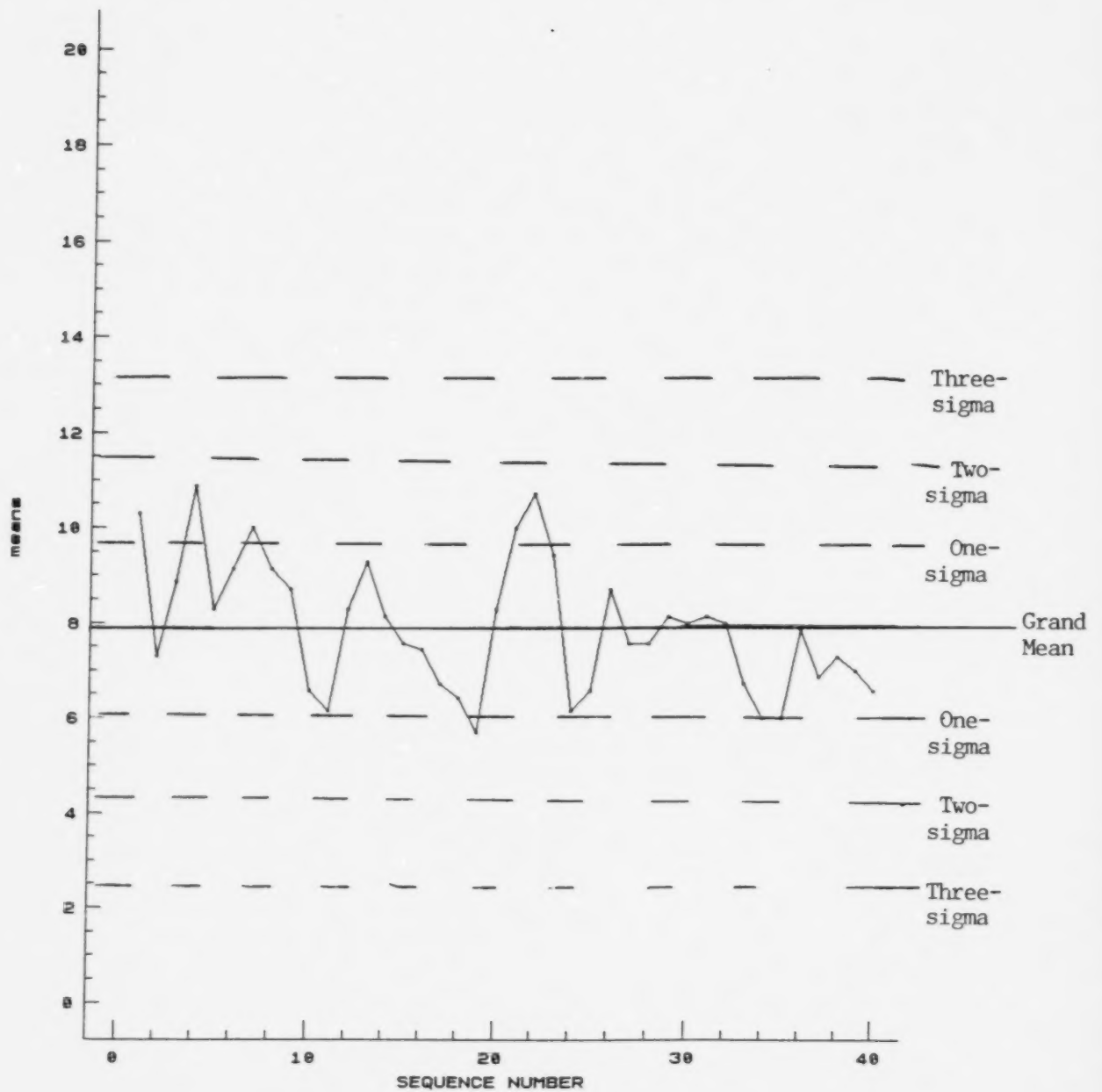
Figure 4. Anticipatory grief scores for participant 3.

Figure 5. Anticipatory grief scores for participant 4.

Figure 6. Anticipatory grief scores for participant 5.

Figure 7. Residual values for participant 6.

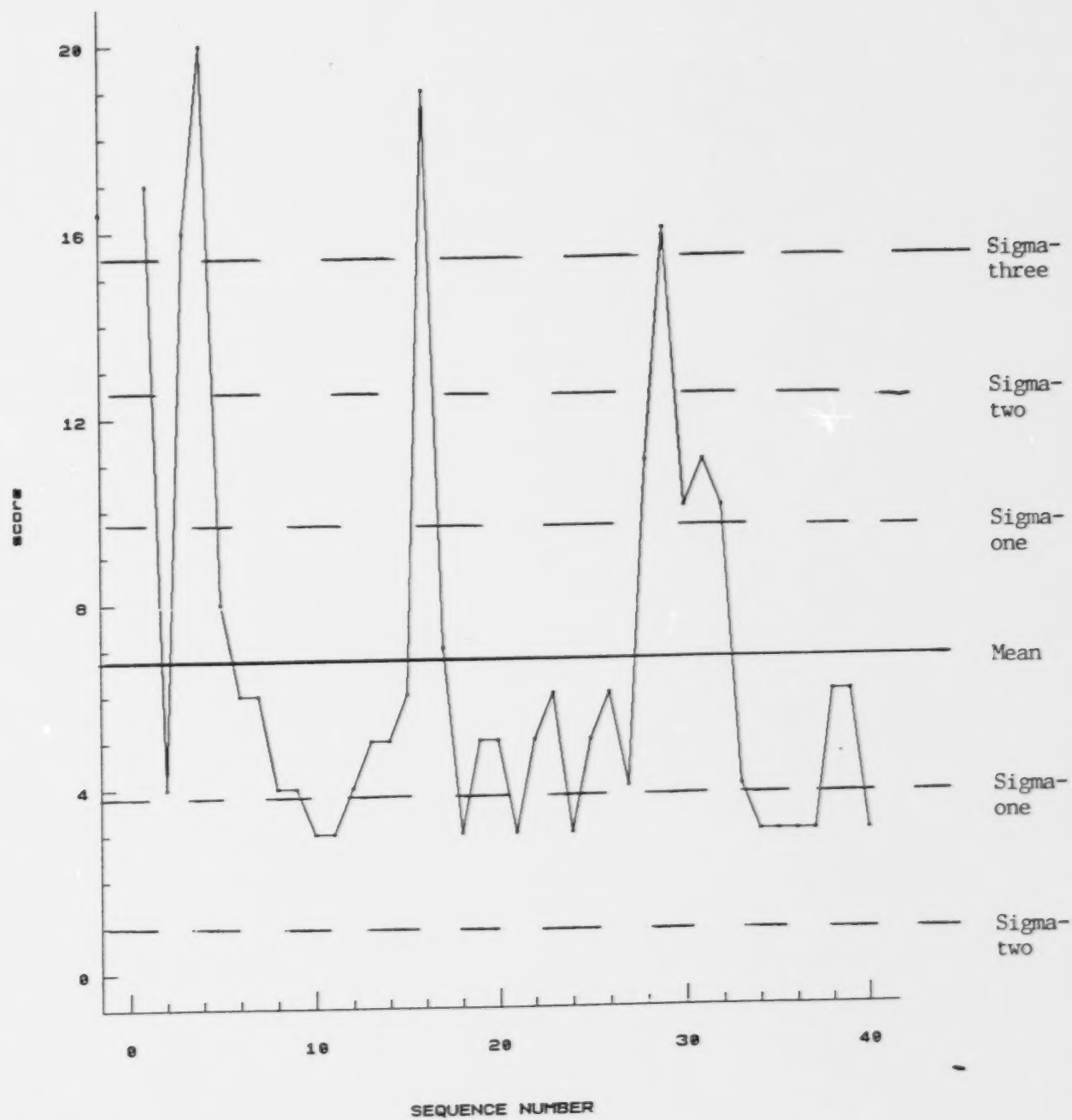
Figure 8. Anticipatory grief scores for participant 7.



Analyzing Data 48

Figure 1

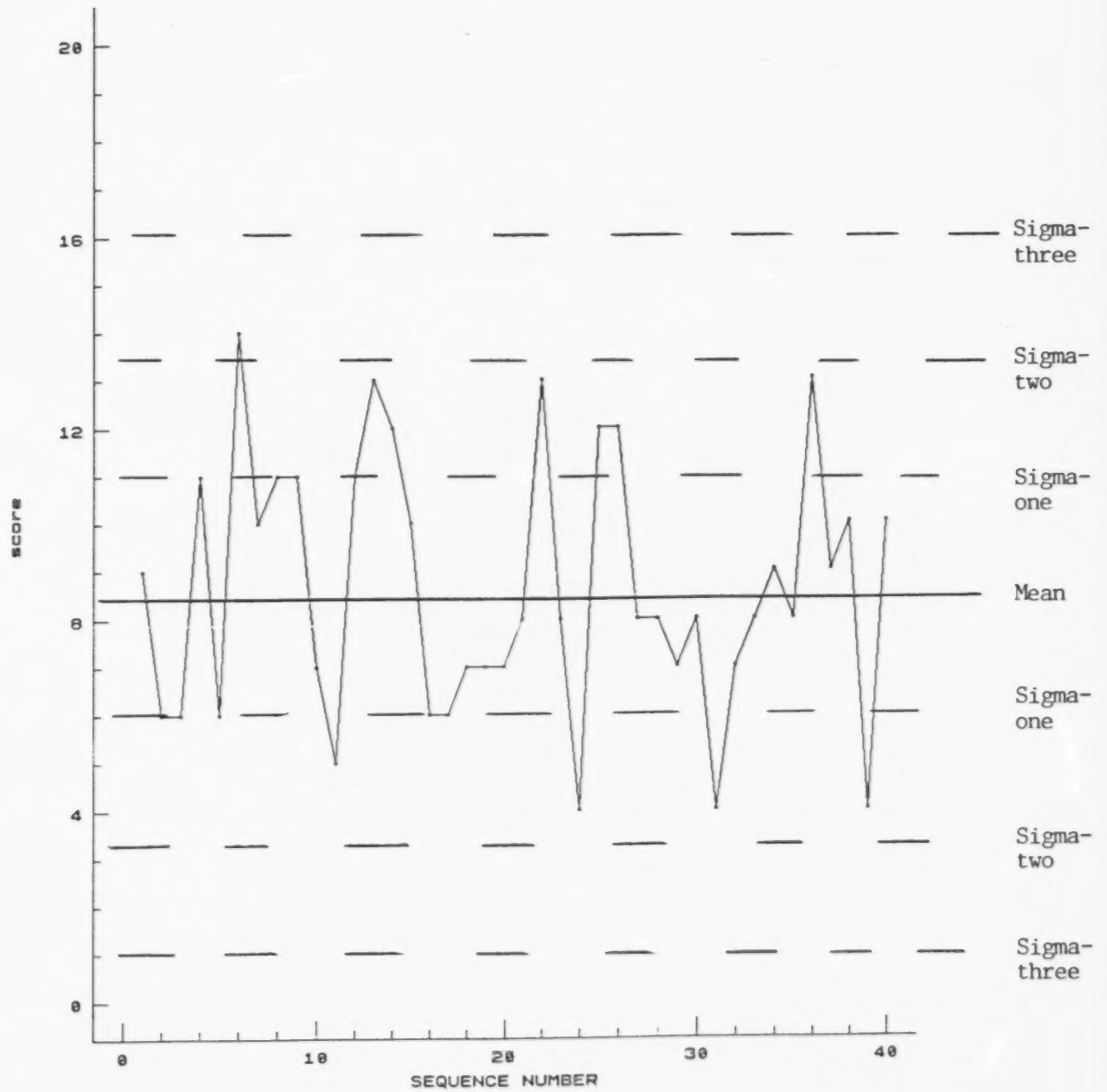
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Figure 2

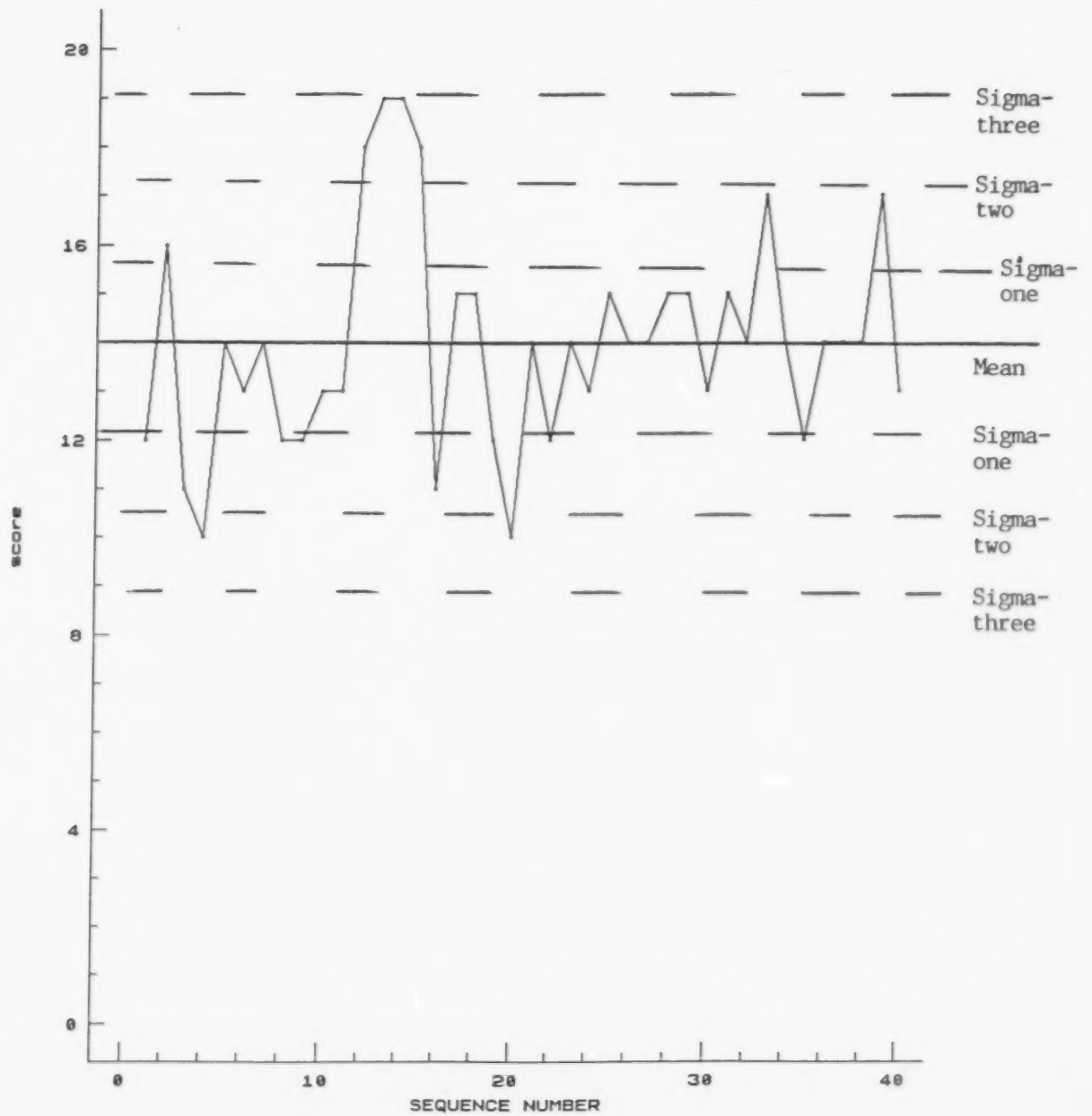
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Analyzing Data 50

Figure 3

TOP

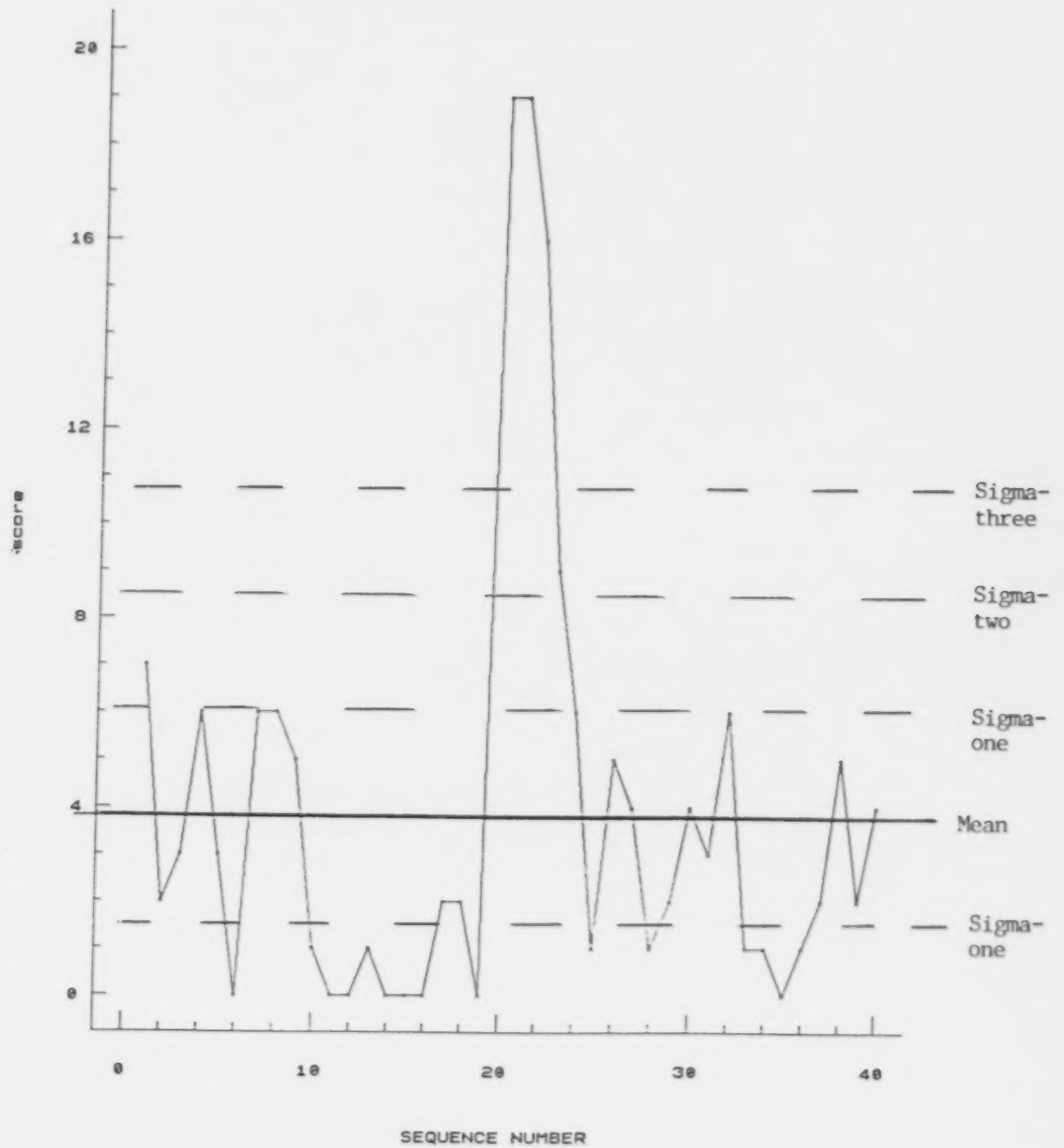


1
2
3
4
5

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Figure 4

TOP

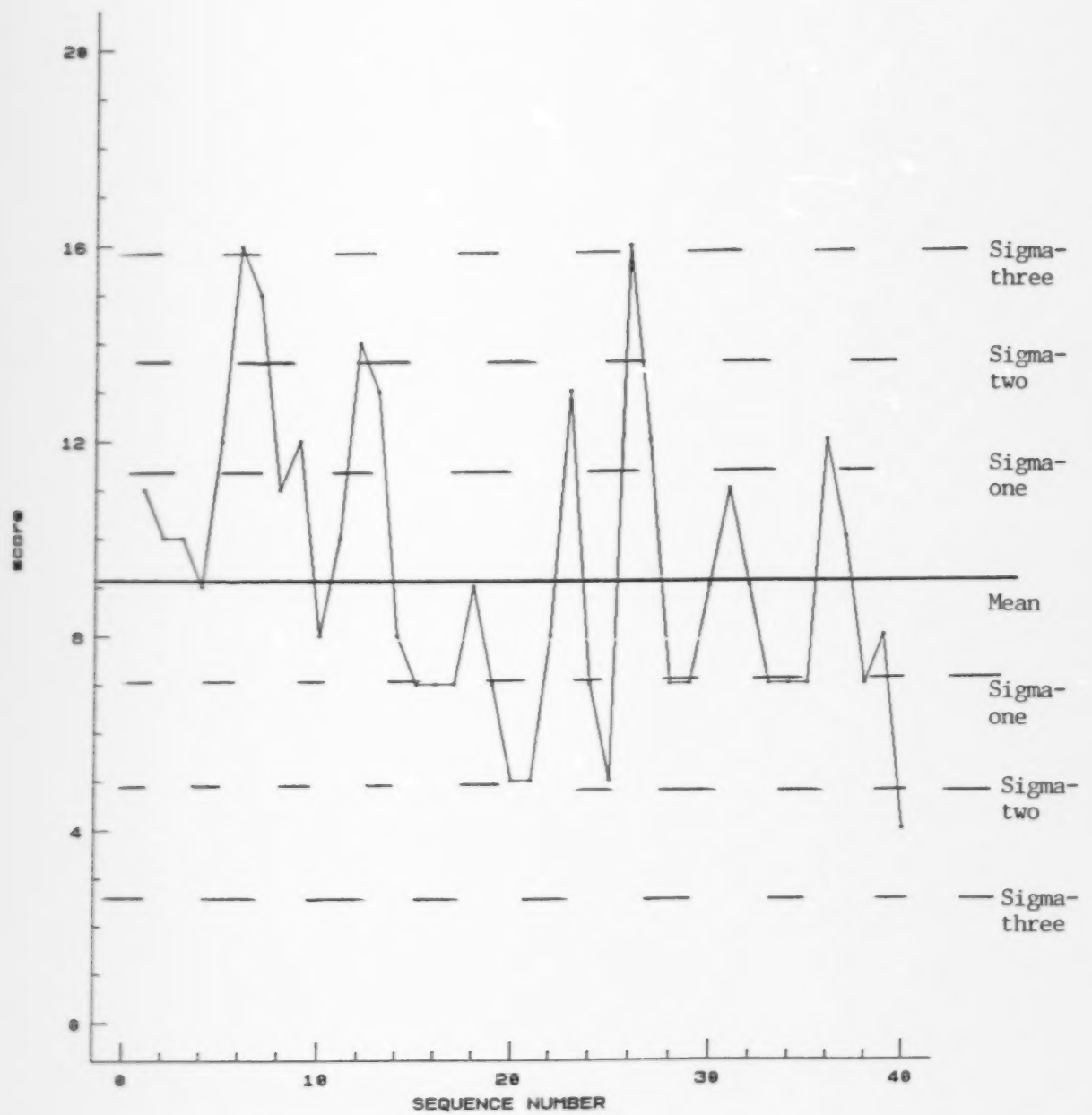


Analyzing Data

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Figure 5

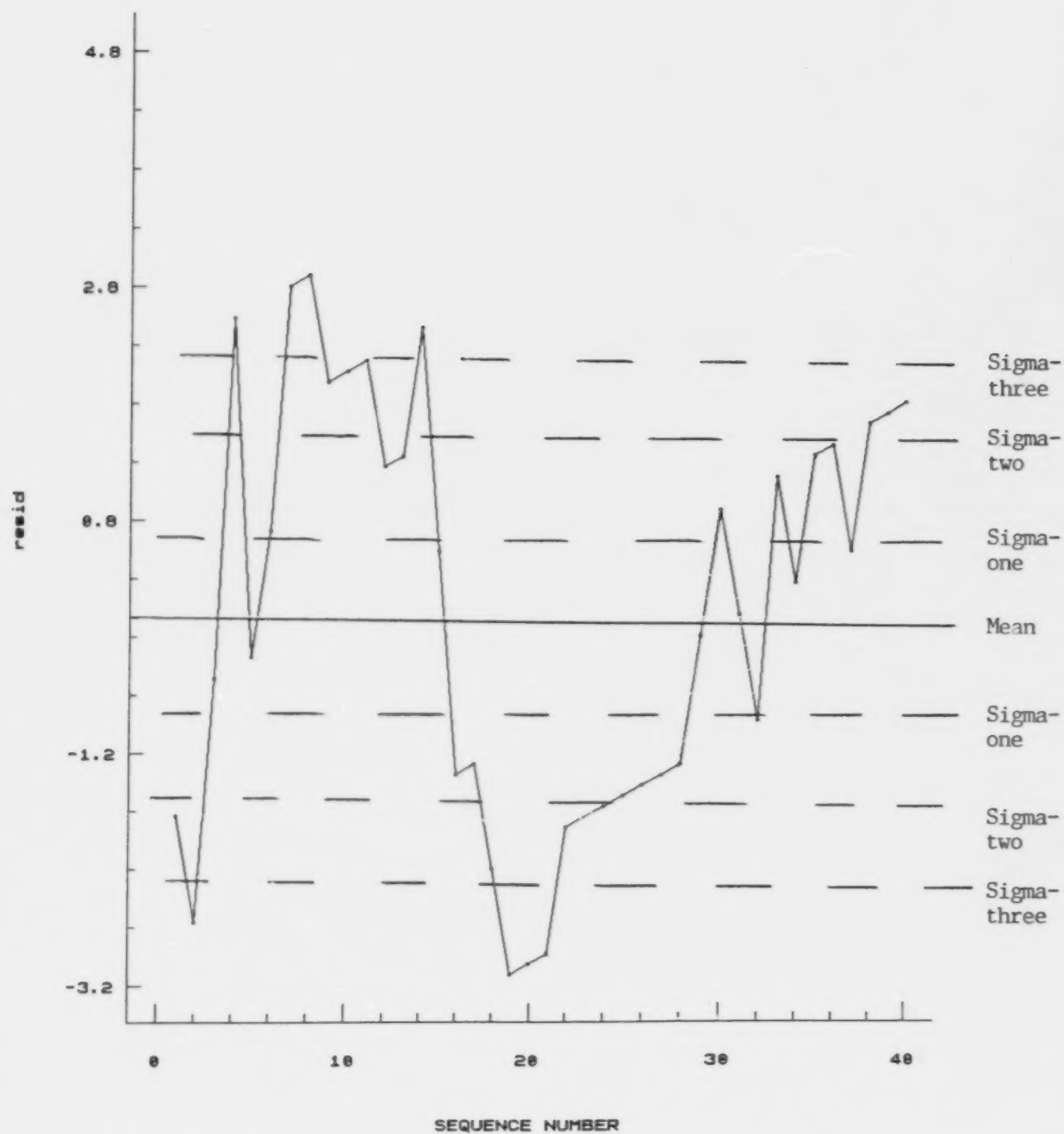
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Analyzing Data 53

Figure 6

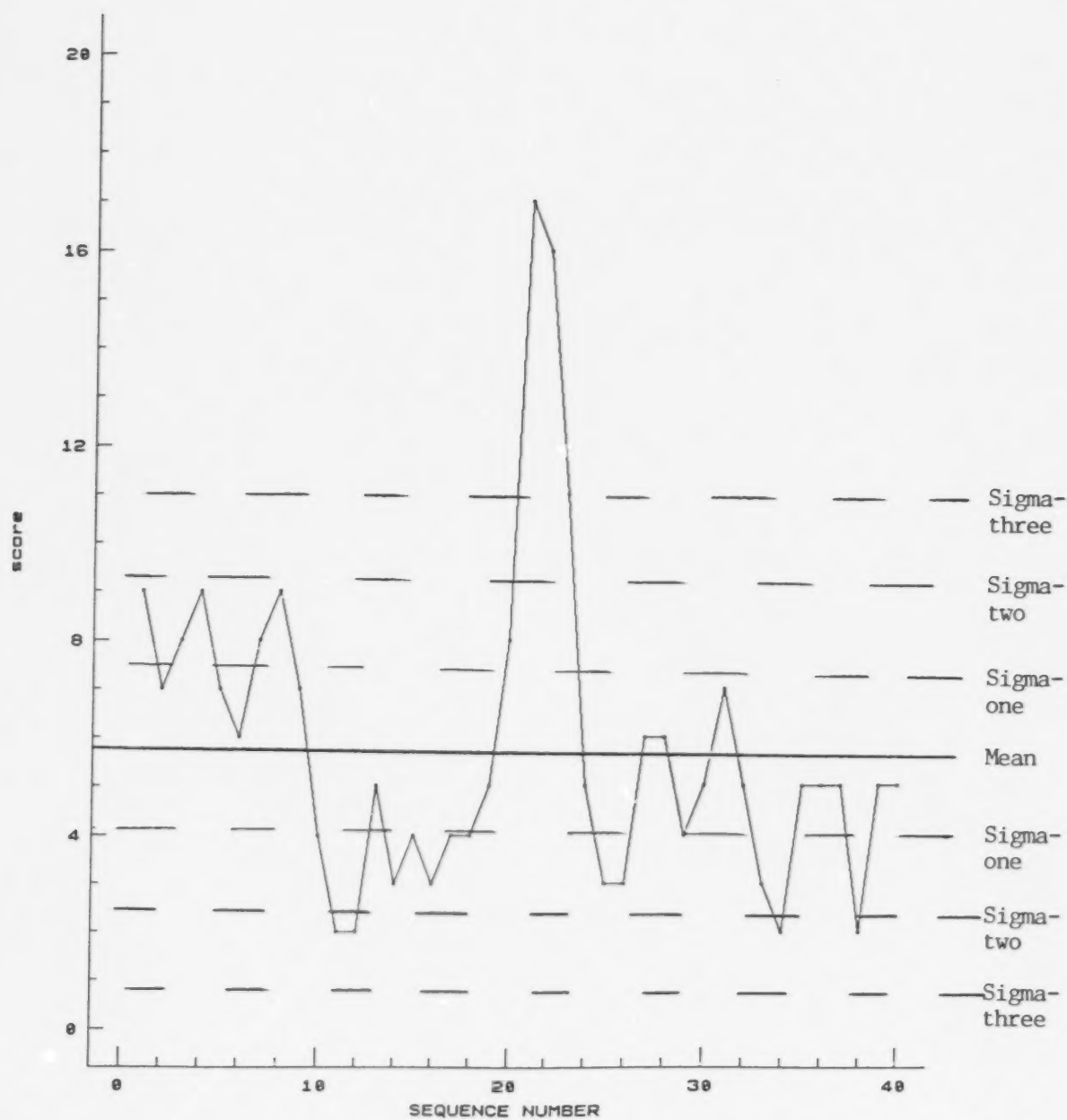
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Analyzing Data 54

Figure 7

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Analyzing Data 55

Figure 8

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